

Chapter 9: Infrastructure

1 Overview and Key Findings

The Delta is located in the geographic center of the Northern California megaregion and serves as an infrastructure hub for the megaregion as well as the local, regional and state economies. While the Delta's importance to the state water system is well-known, its importance to energy, transportation, and in-Delta municipal and industrial water supplies is less appreciated. This chapter focuses on infrastructure that directly serves communities within the Legal Delta and the adjacent region, but it also includes analysis of infrastructure that serves the megaregion and other regions.

An idea of the variety and extent of infrastructure in the Delta is provided by Figure 36.²⁰⁶ This chapter reviews and analyzes the range of infrastructure within the framework detailed in Chapter Six across three critical categories: (1) transportation; (2) energy; and (3) water resources.

The key findings are:

- Levee investments must fully consider the value of infrastructure. Ignoring or incompletely assessing the value and cost of infrastructure could lead to dangerous underinvestment in levees and create risks for energy, transportation, and water supply infrastructure of critical local, regional, and state-wide significance.
- All owners and operators of infrastructure that depend on Delta levees do not currently contribute to levee system investment and maintenance. Some infrastructure owners contribute but others do not.
- Extraction of water from the Delta is critical to the economy. Declining water quality as result of increased salts or organic carbon would significantly increase costs for households, business, and industry in and around the Delta.
- Infrastructure demands within and around the Delta will require significant future investment. It will be necessary to ensure development of the infrastructure in the Delta is aligned with economic sustainability strategies.
- Development of the Delta's transportation infrastructure in general, but especially its ports and marine facilities, will support greater interregional integration, competitiveness, and economic development.
- Delta water quality is potentially threatened by isolated conveyance, some of the conservation measures, and the six-island open-water scenario. However, other proposals such as the Lower San Joaquin River Bypass support multiple goals. The bypass would reduce peak water surface elevations in the San Joaquin River adjacent to Lathrop and Stockton and provide ecosystem benefits from activating floodplains that increase organic carbon for a short duration and during high flows, which would minimize impacts on water quality.

²⁰⁶ Based on DRMS GIS data set developed by URS Corporation and provided by DWR.

Figure 36 Select Delta Infrastructure²⁰⁷



²⁰⁷ For high resolution image see <http://forecast.pacific.edu/desp-figs.html>

The Delta is in the center of the Northern California megaregion; the region is depicted in Figure 37.²⁰⁸ This is one of 11 emerging megaregions in the U.S. identified as drivers of national growth in the 21st century.²⁰⁹ In 2010, the Northern California megaregion's population totaled 14.6 million people. While 80 percent of that population was located within the megaregion's 21-county "core," that core accounted for less than 39 percent of the megaregion's total area.²¹⁰ In 2010, the megaregion's gross regional product exceeded \$780 billion.²¹¹

The map displays the Northern California Megaregion, defined by three concentric zones around the San Francisco Bay Area. The innermost zone, shaded in light green, represents the 'Core' area. The middle zone, shaded in a darker green, represents the 'Sphere of Influence'. The outermost zone, shaded in orange, represents the 'Legal Delta'. The map includes labels for major cities such as San Francisco, Oakland, San Jose, Sacramento, and Fresno, as well as numerous counties including Humboldt, Trinity, Tehama, Butte, Plumas, Lassen, Yuba, Nevada, Placer, El Dorado, Alpine, Inyo, Mono, and others. A legend in the bottom left corner identifies the three zones, and a north arrow is located to its right.

²¹² For high resolution image see <http://forecast.pacific.edu/desp-figs.html>. The geography of the Northern California megaregion is based on G. Metcalf and E. Terplan, "The Northern California Megaregion," SPUR Urbanist, November 2, 1007. Accessed at www.spur.org/publications/library/article/mappingthenortherncaliforniamegaregion11012007

The Northern California megaregion has followed a common development path, characterized by initial nodes being followed by suburbanization and infilling between nodes. This pattern has generated considerable urban development around the Delta and within the Secondary Zone of the Delta itself. However, as detailed in Chapter 4 and 10, a range of planning and land use restrictions have limited urban encroachment in the Primary Zone. Therefore, the Delta's comparatively rural nature and its centrality to the megaregion have combined to reinforce the Delta's historic role as a regional infrastructure hub.

Megaregions like the Northern California megaregion are envisioned to become more cohesive in coming decades as technology and globalization enhances integration of core metropolitan areas and their broader sphere of influence. However, if these agglomeration advantages are to be realized it is critical that the megaregion's infrastructure facilitates integration of the range of economic function contained within its "megazone."²¹³ The Delta's infrastructure services are thereby poised to play an important role in development of the Northern California megaregion's advantages in the global economy in the coming decades.²¹⁴

3 Transportation

Since the discovery of gold in 1848, the Delta has served as a key transportation hub linking the coastal cities of the San Francisco Bay area with the inland cities of the Central Valley and beyond. Contemporary Delta transportation has evolved to provide a critical array of intra- and interregional infrastructure linking the area's population and its diverse concentration of agriculture, manufacturing, distribution, warehousing, and retailers.²¹⁵ Through its transportation corridors the Delta also facilitates public safety, a healthy business climate, and recreational opportunities. As such, the Delta's transportation infrastructure provides important capacity for long-term sustainable growth in the Delta and beyond by facilitating the efficient movement of people and goods. However, access provided by the Delta's transportation infrastructure requires systemic maintenance and investment if it is to enhance and sustain its relevance in a global environment of increasingly efficient, multi-modal, and integrated transportation.

3.1 Road Transportation

There are three state highways in the Delta's Primary Zone (SR 4, SR 12, and SR 160). These highways are principal road transit routes through that region. In addition, the Delta's Secondary Zone hosts three Interstate freeways (I-5, I-80, and I-205) and is bordered by two others (I-580 and I-680). The 2007 Status and Trends of Delta-Suisun Services report identified evidence of Delta traffic growth disproportionate to population growth.²¹⁶ That trend continues to be evident in recent years. Table 42 reports an index of daily total vehicle trips (DTVT) on these transportation corridors between 1992 and 2009 as well as actual 2009 DTVTs. Accordingly, excluding some sections of SR 160, traffic volumes on highways and freeways increased between 23 percent and 65 percent during this period. In comparison, population in the five-

²¹³ P. Todorovich (ed.), *America 2050: An Infrastructure Vision for 21st Century America*. New York: America 2050, 2008. http://www.america2050.org/pdf/2050_Report_Infrastructure_2008.pdf

²¹⁴ S. Sassen, "Megaregions: Benefits beyond Sharing Trains and Parking Lots?" *The Economic Geography of Megaregions*, The Policy Research Institute for the Region, Woodrow Wilson School of Public and International Affairs, Princeton University, February 9, 2007. <http://www.princeton.edu/research/prior-publications/conference-books/megaregions.pdf>

²¹⁵ DPC, *Final Draft Delta Protection Commission Economic Sustainability Plan Framework Study Volume II*, Delta Protection Commission. December 6, 2010.

²¹⁶ DWR, *Status and Trends of Delta-Suisun Services*, Public Review Draft, Department of Water Resources, March 2007.

county region increased by 20 percent, ranging between 12 percent (Solano County) and 26 percent (Yolo County and San Joaquin County) during the same period.²¹⁷

Table 42 Daily Total Vehicle Trips (DTVT) on Key Transportation Routes 1992-2009

Route	Intersection	1992	1995	2000	2005	2006	2007	2008	2009	2009 DTVTs
CA-12	CA-84 (Rio Vista)	100	93	111	147	150	150	134	129	39,000
CA-12	I-5 (Lodi)	100	99	97	151	153	153	134	134	31,000
CA-160	CA-220 (Walnut Grove)	100	64	73	80	81	81	70	70	4,700
CA-160	Wilbur Ave (Antioch)	100	94	113	125	140	136	124	123	25,000
CA-160	Isleton Bridge (Isleton)	100	71	73	80	81	81	73	73	6,150
CA-4	Byron Highway (Byron)	100	108	125	131	123	125	112	117	38,600
CA-4	Roberts Road (Stockton)	100	115	N/A	N/A	165	153	139	135	19,400
CA-4	Port Chicago Freeway (Concord)	100	105	140	184	177	179	171	165	277,000
I-205	Old Route 50 (Tracy)	100	115	139	169	170	170	180	160	195,000
I-5	I Street (Sacramento)	100	116	133	161	166	167	155	159	364,000
I-5	CA-12 (Lodi)	100	103	113	166	169	169	156	156	130,000
I-5	French Camp Overcross (French Camp)	100	105	108	174	176	176	159	159	196,000
I-80	I-5 (Sacramento)	100	82	114	124	127	134	128	126	231,000
I-80	CA 113 (Davis)	100	107	123	137	135	130	126	135	246,000

Source: Caltrans traffic volume data. Traffic Data Branch. Accessed June 30, 2011:

<http://www.dot.ca.gov/hq/traffops/saferesr/trafdata/index.htm>

Box 2 California State Route 12 Corridor: Challenges and Opportunities

Many of the challenges and opportunities of road transportation in the Delta occur along the California State Route 12 corridor, which bisects the Delta from the east at Interstate-5 near Lodi to the west at Rio Vista. The corridor provides important interregional linkages between the Bay Area and the San Joaquin Valley. It is also an important emergency access route into the Delta for first responders. In addition, the corridor is a principal access route for Delta recreators. As such, the corridor has an important role in both inter- and intra-regional growth. However, growing inward Bay Area commuting, expanding freight and goods transportation across the Delta, future development of Rio Vista, and enhanced use of Travis Air Force Base as a passenger/freight airport all pose significant challenges and opportunities for the corridor in general and the Delta in particular. These potential increases in demand on the corridor create opportunities to enhance access for existing in-Delta users, expand multi-modal access within and across the Delta, as well as increase the corridor's general safety and facilitate marketing of the Delta as a place. Nonetheless, the increased demand may also generate congestion, enhance negative environmental effects, degrade safety along the corridor, and inhibit access to other parts of the Delta. The presence of several drawbridges along the route adds further complexity to the associated challenges as increased recreational usage and shipping to the Port of West Sacramento may compound congestion along this important road transportation corridor. However, as discussed later in this chapter, development of the M-580 Marine Highway Corridor may relieve some congestion by decreasing the number of drayage trucks.

(Source: The information above is a compilation of issues drawn from the Moving Forward State Route 12 Corridor Study. For further information see: www.movingforward12.com)

The decline in vehicle traffic along SR 160 is notable. SR 160 has Scenic Roadway designation and as such it is an important driving-for-pleasure resource within the Delta. When examined, the largest decline in vehicle traffic occurred between 1992 and 1995, with some recovery followed by a period of flat to slightly declining traffic volumes along SR 160 in the northern Delta between 1995 and 2009, and with some growth in the southern portion of the route.²¹⁸

²¹⁷ Population calculations based on Census Bureau midyear population estimates. Accessed from: <http://www.census.gov/popest/counties/counties.html>

²¹⁸ See Chapter 8, Recreation and Tourism for a discussion of trends in driving for pleasure in the Delta.

The trends in truck traffic are more diverse as indicated in Table 43. Truck traffic has decreased markedly in some areas, such as the 45 percent decline in truck traffic on I-80 near Davis. However, truck traffic has increased in other areas, particularly along the I-5 corridor: traffic increased by 112 percent near Lodi, 66 percent near Sacramento, and 59 percent near French Camp.

Table 43 Daily Total Truck Trips (DTTT) on Key Transportation Routes 1992-2009

Route	Intersection	1992	1995	2000	2005	2006	2007	2008	2009	2009 DTVTs
CA-12	CA-84 (Rio Vista)	100	90	87	136	137	137	120	120	3,871
CA-12	I-5 (Lodi)	100	78	76	90	92	92	83	83	4,519
CA-4	Byron Highway (Byron)	100	80	124	130	123	124	111	116	5,775
CA-4	Roberts Road (Stockton)	100	103	137	76	164	152	138	134	2,471
CA-4	Port Chicago Freeway (Concord)	100	97	109	139	134	135	129	124	14,779
I-205	Old Route 50 (Tracy)	100	114	138	103	104	104	110	94	12,240
I-5	I Street (Sacramento)	100	120	136	166	171	173	162	166	17,856
I-5	CA-12 (Lodi)	100	142	144	231	233	233	212	212	23,459
I-5	French Camp Overcross (French Camp)	100	124	138	151	153	174	159	159	49,480
I-80	I-5 (Sac)	100	111	156	131	134	140	135	132	16,428
I-80	CA 113 (Davis)	100	59	69	55	53	54	52	55	8,107

Source: Caltrans traffic volume data. Traffic Data Branch. Accessed June 30, 2011:
<http://www.dot.ca.gov/hq/traffops/saferesr/trafdata/index.htm>

The Delta's central location in the Northern California megaregion and the significant highway and freeway infrastructure through and around it make it an important road transportation hub. Proximity to the large urban populations in the Bay Area, with comparatively less expensive property, further facilitates road freight, logistics, and other supply-chain facilities in parts of the Delta's Secondary Zone as well as adjoining areas. This road freight transportation nexus is additionally supported by I-5 & CA-99 which provide north-south access from Mexico to Canada as well as I-80 which provides road freight transportation linkages to the eastern U.S. Given the trends in road-based freight transportation and continued population growth in the megaregion characterized by increased integration, the baseline trend for the Delta's road transportation infrastructure is further growth in demand.²¹⁹

Table 44 Legal Delta Road Infrastructure in 100-year floodplain²²⁰

	Quantity	Asset Value (millions)
Highway Bridges (count)	182	353.4
Highway Roads (miles)	182	316.9
Non-Highway Bridges (count)	41	21.5
Minor Roads (miles)	1,453	1,534.5
Major Roads (miles)	157	274.1

Utilizing the Department of Water Resources (DWR) Delta Risk Management Strategy (DRMS) Phase 1 study of infrastructure in the Delta,²²¹ we are able to identify both road infrastructure in the Delta's current 100 year floodplain and that study's estimate of this road infrastructure's

²¹⁹ It is important to note that this analysis has not examined the likelihood of further provision of road infrastructure in the Delta.

²²⁰ These figures were derived from Table 7-2a in DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Impact to Infrastructure*, June 15, 2007. See Appendix J for further details.

²²¹ Table 7-2a from DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Impact to Infrastructure*, June 15, 2007.

asset value.²²² As seen in Table 44, the Delta has nearly 1,800 miles of road and over 220 bridges in its 100-year floodplain.²²³ In total, the asset value of this road infrastructure is estimated to be in excess of \$2.5 billion. Besides the infrastructure identified in Table 44, it is worth noting that there are also five operational ferries in the Delta's 100-year floodplain; two of the five ferries are operated by Caltrans and the other three ferries are privately operated.²²⁴ This road infrastructure is dependent upon the Delta's flood protection system to prevent damage during flooding events. While the baseline assumes PL 84-99 standards for all levees in the Delta, at this standard there is still significant risk of damage from flooding and earthquake events.²²⁵

3.2 Rail Infrastructure

The Delta's short-line railroad was historically an important transportation resource for the region's agricultural industry.²²⁶ Currently, two of the largest railroads in North America, Burlington Northern Santa Fe (BNSF) railway and the Union Pacific railroad (UPRR),²²⁷ possess an extensive rail network that passes through and encircles the Delta as it links the Bay Area with the Central Valley and beyond. These lines are further complemented by short-line and rail rapid transit systems within and adjoining the Delta to form an extensive regional rail transport infrastructure with multimodal linkages.

The Delta's rail freight infrastructure is a critical component of the regional transportation system. Rail access to the Port of West Sacramento and the Port of Stockton facilitates the ports' role as regional bulk and general cargo provision. Freight rail is particularly competitive with long-distance freight, which facilitates outward and inward shipment of goods from across California, the nation, and internationally. Railroads are also four times more fuel efficient than trucks on average, which reduces emissions.²²⁸ Therefore, the rail freight system affords reduced congestion on the road infrastructure by relieving the need for long-haul trucking and by providing a greater carrying capacity. These efficiencies in rail freight offer an important means to facilitate economic expansion in the megaregion without excessively burdening the local environment.

In addition to freight transportation, there is an established passenger rail network that passes through the Delta and provides important interregional connections. The Amtrak San Joaquin route provides rail services from Bakersfield to Sacramento and Oakland. The San Joaquin thereby provides passenger rail services through a large portion of the Central Valley and the

²²² This 100-year floodplain is an imaginary boundary that defines the area around the Delta, an overview of this boundary is provided in Figure 13-1 in DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Impact to Infrastructure*, June 15, 2007. Throughout estimates are derived by the authors as they were not identified in the DWR report as such.

²²³ Figure D2 in Appendix D is a map which shows islands in the Delta 100-year floodplain that protect highways.

²²⁴ Caltrans, *SR-12 Comprehensive Corridor Evaluation and Corridor Management Plan from SR-29 to I-5*, 2011.

²²⁵ The DRMS study has conducted a road closure cost estimate with daily costs ranging between \$100,000 and \$24,060,000 per day. Table 24 in DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Economic Consequences*, Department of Water Resources, May 2008.

²²⁶ DPC, Utilities and Infrastructure, Background Report, 1994.

²²⁷ Together BNSF and UPRR accounted for 47 percent of all freight railroad revenue in the United States in 2009. Note: Author's calculation based on AAR (2011) and AAR (2010).

²²⁸ AAR (2011) "An Overview of America's Freight Railroads," *American Association of Railroads, Background Paper*. April 2011.

Bay Area. It also provides access to other Amtrak routes including the Capitol Corridor, which travels just outside the Legal Delta but also provides an important interregional rail link between the Central Valley and the Bay Area.

Table 45 presents an index of Amtrak ridership, measured in terms of passengers boarding and detraining, at select stations along the San Joaquin route. While the individual stations' ridership varied considerably, they all have seen a steady growth ranging between 23 percent and 67 percent increases from 2004 to 2010. Across the entirety of the San Joaquin route there were 960,165 passenger trips in 2010.²²⁹

Table 45 Index of Amtrak Passengers Boarding & Detraining (PBDs) by Station, 2004-2010 and 2010 Value

Station	2004	2005	2006	2007	2008	2009	2010	2010 PBTs
Sacramento	100	108	107	113	133	129	128	1,090,122
Lodi	100	91	104	95	126	122	123	7,443
Stockton	100	97	109	109	128	126	135	234,678
Modesto	100	98	104	109	129	127	134	95,532
Antioch	100	102	110	118	141	140	167	34,417

Source: National Association of Railroad Passengers, Amtrak factsheets. Accessed June 30, 2011:
<http://www.narprail.org/cms/images/uploads/fels/index.htm>

Box 3 Intermodal Transportation of Freight

Intermodal freight is an important component of transportation in and around the Delta. Szyliowicz (2000) describes intermodal transport: *“Intermodal freight transport involves the transportation of freight in an intermodal container or vehicle, using multiple modes of transportation (rail, ship, and truck), without any handling of the freight itself when changing modes. The method reduces cargo handling, and so improves security, reduces damages and losses, and allows freight to be transported faster.”* Central to intermodal transport is maximization of each mode's comparative advantage to simultaneously optimize existing resources while enhancing component productivity as well as the overall productivity of the entire transportation system. Intermodal freight transport has been the fastest growing segment of rail freight traffic over the past quarter century (AAR 2011: 2). As a result of its decreasing traffic congestion and transportation costs, intermodal freight in and around the Delta supports the inter- and intra-regional competitiveness of the Northern California megaregion. According to the AAR (2011) nearly 60 percent of intermodal rail consist of imports or exports, which also makes intermodal transport an important component of international trade. While there are no intermodal terminals in the Delta itself, there are six intermodal terminals operated by BNSF and UPRR in the five-county region. These facilities have and/or are developing ties with nearby logistics clusters, in-Delta and nearby -ports, and warehousing facilities. Furthermore, through rail linkages across the Central Valley and beyond, intermodal rail more generally facilitates California's foreign trade.

Sources: Szyliowicz, J.S. (2000) *Intermodalism: The Challenge and the Promise*. NCIT Final Report.
AAR (2011) “An Overview of America's Freight Railroads,” *American Association of Railroads, Background Paper*. April 2011.

The Altamont Commuter Express (ACE Rail) is another important passenger rail network that passes through the Delta. ACE Rail is a commuter train operating between Stockton and San Jose. It thereby facilitates workers in the Silicon Valley accessing more affordable housing from the Central Valley. Table 46 presents an annual index of ridership across the entirety of the ACE Rail route between 2004 and 2010. While there were 676,444 passenger trips on ACE Rail in 2010, the economic recession appears to have significantly depressed ridership along the route beginning in 2009.

²²⁹ NAPRAIL, *Amtrak Fact Sheet: San Joaquins Service*. Accessed June 30, 2011:
<http://www.narprail.org/cms/images/uploads/fels/trains/39.pdf>

Table 46 Index of ACE Rail Ridership 2004-2010 and Actual Passengers in 2010²³⁰

	2004	2005	2006	2007	2008	2009	2010	2010 Passengers
Total Annual Ridership	100	96	105	117	134	106	105	676,444

Source: ACE Rail ridership information was provided by the San Joaquin Regional Rail Commission

These three passenger rail corridors each rank among the busiest in the United States.²³¹ Especially in the context of the projected growth that will occur in the megaregion over the next few decades, it is likely that this regional rail infrastructure, including those parts in the Delta, will experience significant growth in demand.²³²

Table 47 Legal Delta Rail Infrastructure in 100-year floodplain²³³

	Quantity	Asset Value (millions)
Rail Facilities (count)	9	23.2
Rail Bridges (count)	10	10.0
Railroads (miles)	74	111.7

Utilizing the DWR DRMS Phase 1 study of infrastructure in the Delta,²³⁴ we are able to identify both rail infrastructure in the Delta's current 100-year floodplain and that study's estimate of this rail infrastructure's asset value. As seen in Table 47, the Delta has 74 miles of railroad and 10 bridges in its 100-year floodplain.²³⁵ In total, the asset value of this rail infrastructure is estimated to be in excess of \$145 million. It is important to note that the rail infrastructure reported in Table 47 includes some historic short-line railroads which are not currently operated. The rail infrastructure identified in the table is dependent upon the Delta's flood protection system to prevent damage during flooding events. While the baseline assumes PL 84-99 standards for all levees in the Delta at this standard there is still significant risk of damage from flooding and earthquake events.²³⁶

3.3 Ports and Maritime Infrastructure

The Delta hosts several ports, the most significant being the Port of Stockton and the Port of West Sacramento.²³⁷ The Stockton Deep Water Ship Channel was constructed in 1927 and the

²³⁰ ACE Rail ridership information was provided by the San Joaquin Regional Rail Commission and compiled by the ESP project team.

²³¹ Amtrak, "National Fact Sheet: FY2010," 2011. Accessed at: <http://www.amtrak.com/>

²³² It is important to note that this analysis has not examined the likelihood of further provision of rail infrastructure in the Delta or other areas.

²³³ These figures were derived from Table 7-2a in DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Impact to Infrastructure*, June 15, 2007. See Appendix J for further details.

²³⁴ Table 7-2a from DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Impact to Infrastructure*, June 15, 2007.

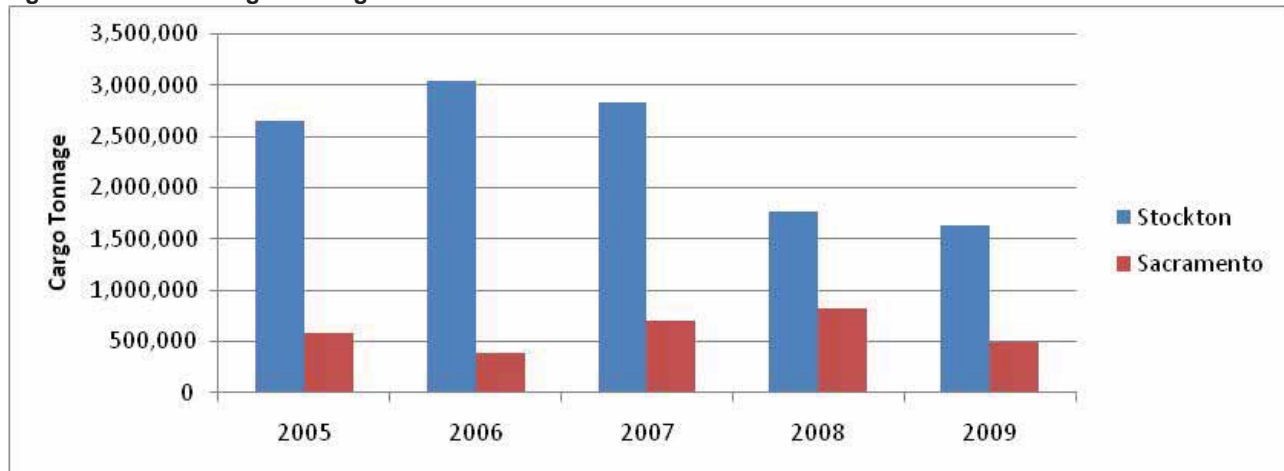
²³⁵ Figure D3 in Appendix D is a map which shows islands in the Delta 100-year floodplain that protect the BNSF railway.

²³⁶ The DRMS study has conducted a rail closure cost estimate with daily costs ranging between \$202,625 and \$804,000 per day. Tables 25 and 26 in DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Economic Consequences*, Department of Water Resources, May 2008.

²³⁷ According to *World Port Source* the Delta hosts five ports with some cargo capacity. These are: Port of Pittsburg, Port of Stockton, Port of West Sacramento, Rio Vista Harbor, and San Joaquin Harbor. Accessed at: www.worldportsource.com

Sacramento Deep Water Ship Channel in 1963.²³⁸ The Port of West Sacramento is located 79 nautical miles from the Golden Gate Bridge and consists of 150 acres of operating terminals that currently handle a variety of bulk, break-bulk (general cargo), and project cargos. The Port of Stockton is located 75 nautical miles from the Golden Gate Bridge; it operates a diversified transportation center that encompasses 2,000 acres of operating area.²³⁹

Figure 38 Annual Cargo Tonnage Ports of West Sacramento and Stockton 2005-2009



Source: U.S. Army Corps of Engineers Waterborne Commerce Statistics Center. Accessed June 30, 2011: <http://www.ndc.iwr.usace.army.mil/wcsc/webpub09/webpubpart-4.htm>

Facilitated by their rail linkages to the BNSF and UPRR networks, both the Port of Stockton and the Port of West Sacramento have become increasingly important shipping centers for bulk and

Box 4 Delta Shipping and the M-580 Marine Highway Corridor

In 2010, it was announced that the ports of Oakland, Stockton, and West Sacramento would be part of the national Marine Highway Program through a short sea shipping network called the M-580 Marine Highway Corridor. This marine highway will reduce truck transportation of containers on the Bay Area's congested road infrastructure through regularly schedule barge service. When the marine highway is fully operational, these two Delta ports will further deepen the regions' freight transportation infrastructure and significantly deepen multi-modal linkages. Similar to the advantages of rail transportation in comparison to truck transportation, but over smaller distances, the short sea shipping system will alleviate traffic congestion on the region's road infrastructure, and reduce costs as well as enhance air quality because of greater fuel efficiency. The Port of Oakland moves more than 99 percent of the containerized goods moving through Northern California. In 2010, there were 2.3 million containers moved through the Port of Oakland and by 2020 its volume is expected to increase by another 65 percent. Given this expansion and constraints around the port, development of the M-580 will offer significant opportunities for additional linkages beyond transportation and warehousing. In this regard, the Port of Stockton's West Complex development should realize important synergies as it seeks to build out industrial, commercial and maritime use of the former military facility that since 2000 has formed part of the port.

Sources: Port of Oakland website. Accessed at : http://www.portofoakland.com/maritime/facts_cargo.asp

Marad (2010) "Marine Highway Corridor Descriptions," Department of Transportation Maritime Administration. Accessed at: http://www.marad.dot.gov/documents/Marine_Highway_Corridors13_Sep_10.pdf

Port of Stockton, "Port of Stockton West Complex Development Plan," Final EIR, 2004.

²³⁸ DWR, *Status and Trends of Delta-Suisun Services*, Public Review Draft, Department of Water Resources, March 2007.

²³⁹ Port of Stockton website. Accessed at: <http://www.portofstockton.com/>

general cargos as the Port of Oakland has seen its container operations grow in dominance and other ports in the Bay Area reach capacity constraints. Figure 38 illustrates the growing cargo tonnage at both ports before the economic recession decreased tonnage.

As inland ports, both Stockton and West Sacramento are dependent on dredged deep water shipping channels. The levees and islands adjoining these channels provide important flows that prevent the channels from excessively silting-up. Nonetheless, both deep water shipping channels need to be dredged on a regular basis to maintain draft on the river of sufficient depth for vessels to navigate. In the case of the Stockton deep water shipping channel, there have been some challenges maintaining the channel depth at its specified depth of 35 feet at mean lower, low water (MLLW).²⁴⁰ The Port of West Sacramento's deep water shipping channel is specified to a depth of 30 feet MLLW. Currently, both channels are seeking to further deepen their respective depths as demand for channel depths grows amongst the world's cargo ships.²⁴¹

As with the other key components of transportation infrastructure in the Delta, the baseline trend for the Delta's ports and maritime infrastructure is for sustained expansion. This growth will be concentrated in the Ports of Stockton and West Sacramento, but given their existing rail linkages, and regional trends, opportunities exist for the port facilities in the West Delta as well. This expansion also appears likely to be tied to local, statewide and national expansion of foreign trade.

Table 48 Legal Delta Port and Maritime Infrastructure in 100-year floodplain²⁴²

	Quantity	Asset Value (millions)
Maritime Docks & Channel Markers (count)	40	102.9

Again, utilizing the DWR DRMS Phase 1 study of infrastructure in the Delta,²⁴³ we are able to identify both the quantity of infrastructure in the Delta and that study's estimate of this infrastructure's asset value. As seen in Table 48, the Delta has some 40 maritime docks and channel markers.²⁴⁴ In total, the asset value of this infrastructure is estimated to be in excess of \$102 million.

3.4 Air Transportation Infrastructure

There are 11 general aviation airports located within the Legal Delta. These facilities are listed in Table 49. Besides those facilities, there are also small landing strips for property owners' use and small agricultural air strips used by commercial crop-dusting services.²⁴⁵ Sacramento International Airport, Stockton Metropolitan Airport, and Travis Air Force Base are all located near the Legal Delta.

²⁴⁰ Interview with the Port of Stockton, August 18, 2011.

²⁴¹ The Port of Stockton provided an illustrative estimate that an extra foot of draft in the deep water shipping channel would provide another \$180,000 in revenue per vessel. Source: Email to author on August 22, 2011.

²⁴² These figures were derived from Table 7-2a in DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Impact to Infrastructure*, June 15, 2007. See Appendix J for further details.

²⁴³ Table 7-2a from DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Impact to Infrastructure*, June 15, 2007.

²⁴⁴ Figure D5 in Appendix D is a map which shows islands in the Delta 100-year floodplain that border the deep water shipping channels.

²⁴⁵ DPC, *Utilities and Infrastructure*, Background Report, 1994.

Table 49 Aviation Facilities in the Legal Delta

<u>Name</u>	<u>County</u>	<u>City</u>	<u>Category</u>
Byron Airport	Contra Costa	Byron	General Aviation
Las Serpientas Airport	Contra Costa	Brentwood	General Aviation
Funny Farm Airport	Contra Costa	Brentwood	General Aviation
Spezia Airport	Sacramento	Isleton	General Aviation
Tracy Municipal Airport	San Joaquin	Tracy	General Aviation
Kingdon Airport	San Joaquin	Lodi	General Aviation
Lost Isle Seaplane Base	San Joaquin	Stockton	General Aviation
New Jerusalem Airport	San Joaquin	Tracy	General Aviation
33 Strip Airport	San Joaquin	Tracy	General Aviation
Rio Vista Municipal Airport	Solano	Rio Vista	General Aviation
Borges-Clarksburg Airport	Yolo	Clarksburg	General Aviation

Source: <http://www.airport-data.com> - Accessed June 30, 2011.

While there are no major airports in the Delta itself, the growing megaregion's population will likely create increased demand for the aviation facilities around the Delta and could expand demand for aviation facilities in the Delta. However, given the linkages that Delta aviation facilities have with agricultural services and to a lesser degree with recreation, it is likely they will parallel those sectors' baselines of higher-value agricultural crops and growing recreational activities although somewhat less than the broader regional population growth.²⁴⁶

Table 50 Legal Delta Aviation Infrastructure in 100-year floodplain²⁴⁷

	Quantity	Asset Value (millions)
Airports (count)	2	86.2

Utilizing the DWR DRMS Phase 1 study of infrastructure in the Delta,²⁴⁸ we are again able to identify both the quantity of aviation infrastructure in the Delta and that study's estimate of this infrastructure's asset value. As seen in Table 50, the Delta has two airports located within its 100-year floodplain.²⁴⁹ In total, the asset value of this aviation infrastructure is estimated to be in excess of \$86 million.

3.5 Impact of Policy Scenarios on Transportation Infrastructure

While the baseline scenarios for each of the transportation systems have been discussed in their respective subsections, it is worth emphasizing that the risks to infrastructure as a result of potential flooding events is not likely to be limited to the loss of infrastructure itself. In many cases there are alternative routes and/or modes available for much of the Delta's transportation infrastructure. Nonetheless, the capacity of those alternatives is constrained and those constraints may or may not change in the future.

²⁴⁶ See Chapters 7 and 8 for information on the baseline trends in agriculture and tourism respectively.

²⁴⁷ These figures were derived from Table 7-2a in DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Impact to Infrastructure*, June 15, 2007. See Appendix J for further details.

²⁴⁸ Table 7-2a from DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Impact to Infrastructure*, June 15, 2007.

²⁴⁹ Figure D5 in Appendix D is a map which shows islands in the Delta 100-year floodplain that border the deep water shipping channels.

Under the baseline assumption of a PL84-99 standard of levee protection,²⁵⁰ some non-negligible risks remain for parts of the Delta's transportation infrastructure. It is important to recognize the systemic relationships between the Delta's transportation infrastructure and that of the larger megaregion and beyond. Dynamic changes in components outside of the Delta could drastically alter the importance of through-Delta transportation. The robustness of the existing Delta infrastructure could thereby take on very different levels of significance. Based upon discussions with key stakeholders of the various components in the transportation infrastructure system and a review of previous analyses, some of the likely impacts on the Delta's transportation from the policy scenarios presented in Chapter 6 include:

- **Habitat Conservation:** While details of the location of tidal habitat matter; one specific area of concern would be the potential for additional silting of the deep water shipping channel. If the tidal habitat were located next to or near either of the deep water shipping channels, additional silting could occur which would incur significant costs and potentially inhibit commerce with the ports.

- **Open Water Scenario:** In terms of transportation infrastructure, there are minimal assets in the six islands. The existing infrastructure identified through the DWR DRMS study is presented in Table 51.²⁵¹ The infrastructure on the islands is primarily local in nature and would not have significant impacts of the larger regional transportation system.

Table 51 Transportation Infrastructure in the Six Island Open Water Scenario

	Quantity	Asset Value (millions)
Non-Highway Bridges (count)	1	0.5
Minor Roads (miles)	31	33.0

However, presence of the open water would expose the Stockton deep water shipping channel to rougher seas and increase silting, which as discussed above would be problematic and costly to the shipping system.

- **Higher Standard Levees Scenario:** Additional levee protection under this scenario would place the transportation infrastructure well above the 100-year standard. This protection would reduce the risk of local damage to the transportation infrastructure systems and reduce the likelihood of interruptions to the broader regional transportation system with which the Delta's infrastructure is increasingly important.

- **Regulatory Scenario:** The increased regulation scenario would potentially impact maintenance of the transportation infrastructure by adding another layer of approval, with potential delays and costs. In addition, the potential for denial would add risk and uncertainty to transportation infrastructure investments in the Delta. These would increase the costs of infrastructure investments and thereby likely lead to less transportation infrastructure investment in the Delta. Conversely, the streamlining of regulations would reduce delays and associated costs of infrastructure maintenance and facilitate capital investments by making a favorable environment for considered infrastructure projects.

²⁵⁰ See Chapter 5 (Flood Control and Public Safety) and Chapter 6 (Framework for Economic Analysis) for further information regarding this standard as the baseline level of protection.

²⁵¹ Table 7-2a from DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Impact to Infrastructure*, June 15, 2007.

• **Delta Vision Scenarios:** The Delta Vision proposals for National Heritage recognition and land use policies would offer potentially useful means to ensure that transportation infrastructure is consistent with maintaining and evolving the Delta as a place. The enterprise zone designation proposal would support the transportation system and associated enterprise development along the value chain.²⁵² Expansion of the State Park and Recreation Area network could support and be supported by development of the Delta's transportation infrastructure. Lastly, the Delta Investment Fund would also be a useful measure to increase transportation infrastructure that supports the broader consistent sustainable economic growth of the Delta.

4 Energy

The largely rural and unpopulated nature of the Delta's Primary Zone makes it a valuable location for energy infrastructure; significant regional natural gas pipelines, underground natural gas storage, and electricity transmission lines are present in the region. This infrastructure provides critical linkages to nearby electrical generation facilities that are significant features of the State's power generation capacity.

4.1 Natural Gas

The Delta hosts major natural gas pipelines, production, and storage facilities. There is approximately 242 miles of natural gas pipeline with an estimated asset value in excess of \$325 million that serve regional users and the local gas fields in the Delta's 100-year floodplain.²⁵³ There are two major natural fields in the Delta: the Rio Vista Gas Field and the French Camp Gas Field. The Rio Vista Field, the larger of the two, is California's largest natural gas field. Combined, these two fields produced 43 percent of California's non-associated, independent-from-oil production, natural gas and 13 percent of the State's total natural gas production in 2009.²⁵⁴ In the Delta's 100-year floodplain alone, there are an estimated 287 natural gas wells and 111 square miles of natural gas fields.²⁵⁵ Pacific Gas and Electric's (PG&E) underground storage facility at McDonald Island is the largest natural gas storage facility in the state with approximately 82 Bcf of gas storage capacity, which provides up to one-third of PG&E's peak natural gas supply.²⁵⁶ This natural gas infrastructure also has important linkages with the proximate electricity generation facilities. A large portion of the Delta's natural gas infrastructure is located within the Delta's 100-year floodplain and as such may be damaged and disrupted during flooding events even with the baseline PL 84-99 standard of protection.²⁵⁷

²⁵² Currently, there is an enterprise zone in San Joaquin County that covers large parts of the Delta. In addition, conditional designation has been granted to enterprise zones in Pittsburg, West Sacramento, and Sacramento. (Source: California Association of Enterprise Zones, www.caez.org)

²⁵³ These figures were derived from Table 7-2a in DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Impact to Infrastructure*, June 15, 2007. See Appendix J for further details.

²⁵⁴ DOGGR, *Report of the state oil & gas supervisor: 2009*. Department of Oil, Gas, and Geothermal Resources, California Department of Conservation, 2010.

²⁵⁵ These figures were derived from Table 7-2a in DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Impact to Infrastructure*, June 15, 2007. See Appendix J for further details.

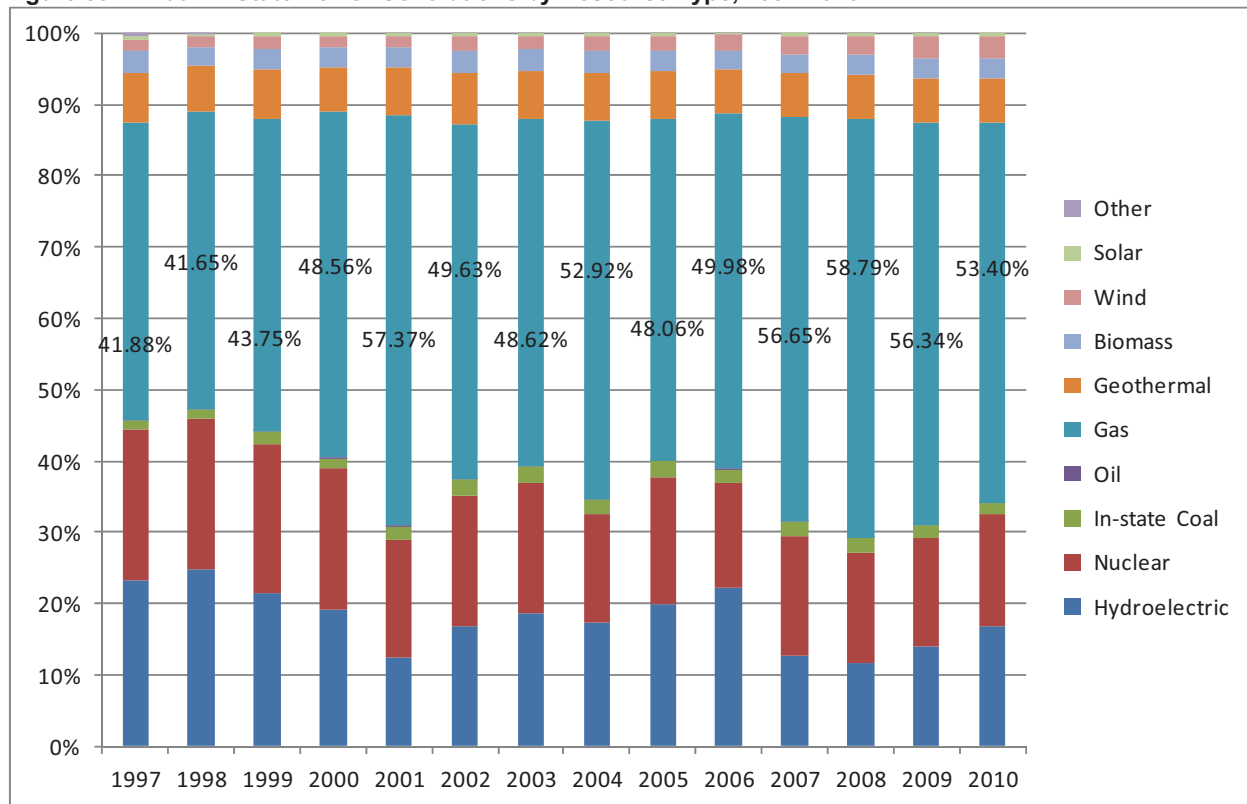
²⁵⁶ California Public Utilities Commission, "California Natural Gas Infrastructure," January 2010.

²⁵⁷ The DRMS study has estimated the monthly winter cost of a loss of the McDonald Island storage facility to be \$114.4 million and the potential daily natural gas well production loss to equal \$870,800. Table 24 and page 54 in DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Economic Consequences*, Department of Water Resources, May 2008. Figure D7 in Appendix D is a map which shows islands in the Delta 100-year floodplain with natural gas storage, fields, and pipelines.

4.2 Electricity Generation Systems

The Legal Delta and nearby power facilities are significant sources of energy for California's electrical grid. Natural gas has become an increasingly significant resource in California's electricity generation, rising in its contribution from 42 percent of the State's total electricity generation in 1997 to 53 percent in 2010.²⁵⁸ This rise in natural gas use in electricity generation is highly relevant given the Delta's natural gas infrastructure. The Legal Delta hosts 23 power plants with generation from natural gas, petroleum coke, wind, biomass, and landfill gas.²⁵⁹ The most significant was natural gas-based generation; in 2010, plants within the Legal Delta generated nearly 10 percent of the State's total natural gas-based electricity, and plants within the five-county Delta region generated nearly 20 percent of the State's total natural gas-based electricity.²⁶⁰

Figure 39 Annual In-State Power Generations by Resource Type, 1997-2010



Source: California Energy Almanac, July 8, 2011 update. Accessed at: <http://energyalmanac.ca.gov/>

The Delta's electricity generation capacity is largely located outside of the 100-year floodplain, but the single power plant located within the floodplain has an estimated asset value of \$130 million.²⁶¹

²⁵⁸ California Energy Commission, *The California Energy Almanac*. Accessed June 30, 2011.

²⁵⁹ For a list of the plants, their Mw capacity, primary fuel, and owner, see Appendix J.

²⁶⁰ Power generation facilities in the Legal Delta generated nearly a third of the State's coal and coal-derived generation, but this only totaled 1,072 Gwh in 2010 and is a product of petroleum coke inputs supplied to these facilities from nearby oil refineries.

²⁶¹ Derived from Table 7-2a from DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Impact to Infrastructure*, June 15, 2007.

4.3 Electricity Distribution Systems

According to the 2007 Department of Water Resources *Status and Trends of Delta-Suisun Services Report*, PG&E, the Sacramento Municipal Utility District, and Western Area Power Administration oversee most of the transmission lines and provide local electricity services within the Delta.²⁶² There are three major electric transmission lines that cross the Delta and interconnect California with loads and generation facilities across the Pacific Northwest. These transmission lines usually operate with combined loads near 4,000MW, but will run loads up to 4,800MW. In total the three lines carry roughly 10 percent of California's summer electricity load. Besides those three major transmission lines, there is a network of lower kilovolt lines in the Delta with combined loads of approximately 1,900MW.²⁶³

Table 52 Legal Delta Energy Transmission Infrastructure in 100-year floodplain²⁶⁴

	Quantity	Asset Value (millions)
Substations (Count)	32	\$32.0
Transmission Lines (miles)	326	\$448.4

Utilizing the DWR DRMS Phase 1 study of infrastructure in the Delta,²⁶⁵ we are able to identify both energy transmission infrastructure in the Delta's current 100-year floodplain and that study's estimate of its asset value. As seen in Table 52, the Delta has 326 miles of transmission lines and 32 substations in its 100-year floodplain. In total, the asset value of this rail infrastructure is estimated to be in excess of \$480 million.²⁶⁶ While the baseline PL 84-99 standard for all levees in the Delta is assumed, flooding and earthquake events at this level of protection are not trivial and could place significant strain on the inter-state distribution system as well as entail significant local outages in and around the Delta.²⁶⁷

4.4 Other Energy Infrastructure

There are several pipelines of major regional significance that carry gasoline and aviation fuel across the Delta from Bay Area refineries to depots for distribution throughout Northern California and Nevada. This pipeline infrastructure extends from the Delta to Sacramento and Stockton onwards to Fresno and Bakersfield as well as to Chico and Reno. These pipelines supply roughly half of all transportation fuel used in the megaregion as well as being the principal source of fuel to several military bases across Northern California and Nevada.²⁶⁸

²⁶² DWR, *Status and Trends of Delta-Suisun Services*, Public Review Draft, Department of Water Resources, March 2007.

²⁶³ DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Economic Consequences*, 2008.

²⁶⁴ These figures were derived from Table 7-2a in DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Impact to Infrastructure*, June 15, 2007. See Appendix J for further details.

²⁶⁵ Table 7-2a from DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Impact to Infrastructure*, June 15, 2007.

²⁶⁶ Figure D8 in Appendix D is a map which shows islands in the Delta 100-year floodplain that protect electric power transmission lines and substation.

²⁶⁷ The DRMS study has conducted a power distribution cost estimate focused on two of the three major transmission lines with a two-month outage estimated costs equal to \$42 million. Tables 19 in DWR, *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Economic Consequences*, Department of Water Resources, May 2008.

²⁶⁸ DWR 2007 *Status and Trends of Delta-Suisun Services*. Public Review Draft. Department of Water Resources. March 2007.

Table 53 Legal Delta Fuel Infrastructure in 100-year floodplain²⁶⁹

	Quantity	Asset Value (millions)
Petroleum Pipelines (miles)	70	\$77.3
Oil Depot (count)	10	\$30

Utilizing the DWR DRMS Phase 1 study of infrastructure in the Delta, we identified approximately 70 miles of fuel pipeline and 10 oil depots in the Delta's current 100-year floodplain worth an estimated \$107 million. While the baseline PL 84-99 standard for all levees in the Delta is assumed, the potential loss of this critical infrastructure would require massive mobilization of tanker trucks to minimize as far as possible associated fuel disruptions.²⁷⁰

Lastly, it is significant that the geologic structure of the Delta's associated sedimentary basin also appears to offer promising opportunities for potential CO₂ sequestration (capture and storage of carbon dioxide). This important potential development to reduce atmospheric man-made CO₂ emissions has identified the Delta's Sacramento Basin as one of the five most promising basins for CO₂ sequestration from an analysis of over 100 basins in California.²⁷¹

4.5 Impact of Policy Scenarios on Energy Infrastructure

The baseline scenario for the various components of energy infrastructure in the Delta is assumed to be highly correlated with that of the Northern California megaregion. In general, the Delta's energy infrastructure should expand at a rate near to that of the megaregion. However, risks from flooding and earthquake events under the PL84-99 levee standard are assumed to have a greater downside probability, thereby decreasing the relative and absolute extent of the Delta's energy infrastructure. In addition, changes in power generation and transmission as well as fuel technologies or associated resources may increase or decrease the attractiveness of the Delta as an energy infrastructure node. With these caveats, some of the likely impacts on the Delta's energy infrastructure from the policy scenarios presented in Chapter 6 include:

- **Isolated Conveyance Scenario:** This is likely to have relatively minor direct impacts on the Delta's energy infrastructure. However, there are probable indirect impacts on at least some of the energy infrastructure as a result of increased energy requirements for pumping capacity in the isolated facility.
- **Habitat Conservation:** While this is also likely to be relatively minor, some conservation measures such as tidal habitat may restrict access to natural gas fields.
- **Open Water Scenario:** Based on our analysis of existing infrastructure identified through the DWR DRMS study, the only component of energy infrastructure in the six islands is a natural gas field on Webb Island. That infrastructure consists of an 83-acre natural gas field, one

²⁶⁹ These figures were derived from Table 7-2a in DWR (2007) *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Impact to Infrastructure*, June 15, 2007. See Appendix J for further details.

²⁷⁰ The DRMS study has estimated costs on California consumers alone (excluding Northern California and military bases) from a loss of two of the systems to equal at least \$25 million per day. Page 58 in DWR (2008) *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Economic Consequences*. Department of Water Resources, May 2008.

²⁷¹ Downey and Clinkenbeard, 2005. *An Overview of Geologic Carbon Sequestration Potential in California*. California Geological Survey.

natural gas well, and a quarter mile of natural gas pipeline with an estimated asset value of \$250,000.²⁷²

- **Higher-Standard Levees Scenario:** Assuming other factors are held constant, a higher level of levee protection would reduce the risks of energy infrastructure losses and likely lead to a greater probability for expansion of the Delta's energy infrastructure with associated investment above the baseline.

- **Delta Vision Scenarios:** As with Transportation infrastructure, the Delta Vision proposals for National Heritage recognition and land use policies would offer a potentially useful means to ensure that energy infrastructure is consistent with maintaining and evolving the Delta as a place.

5 Water Resources

5.1 Water Supply Infrastructure for Delta Communities and the Delta Region

Communities in and surrounding the Legal Delta rely on a variety of water supplies including groundwater, direct diversions from natural flows in the Delta, and diversion of surface water supplies that originate upstream from the Delta. For simplicity, this section focuses on municipal water supplies for Delta communities that divert water directly from the Delta. The largest municipal sources in this category are the Contra Costa Water District, which has several

Box 5 Salinity Impacts on Industrial Users of Delta Water

Beside agriculture, there are numerous industrial users of water from the Delta. These industries are primarily located in or near the western Delta and include power plants, steel mills, and oil refineries. Some of these industrial users maintain their own Delta intakes while others are provided industrial water by the local water districts. A large amount of water is used by these industries as boiler feedwater and for their cooling towers. Because of strict water quality requirements for optimal performance, degradation such as that from increased salinity reduces operating efficiencies or increases the cost of pre-treatment and creates adverse economic impacts. By way of illustrating these impacts on cooling tower systems, we examine an example of two refineries that are supplied industrial water by Contra Costa Water District. Increased salinity reduces thermal conductivity, decreasing cooling tower performance, and requires more water to cycle through to maintain performance. It was estimated that a 20 percent increase in salinity above average would require an additional 17 percent increase in industrial water purchases for the cooling towers' operation. Those increased water purchases would add approximately \$985,000 in costs per year for the two refineries combined. The higher salinity would also accelerate corrosion of the cooling systems with associated increased costs for replacement, downtime, and reduced operating efficiency. There are numerous industrial customers in the Delta area whose operations would likely be significantly affected by increased salinity in the Delta. Therefore, the annual costs associated with increased salinity would be much greater than the illustrative estimate.

Note: This discussion draws on comments and estimates made regarding the August 9, 2011 Draft version of the ESP. Those comments were made by the Contra Costa Water District and are available at the Delta Protection Commission website: http://www.delta.ca.gov/ESP_Comments.htm.

intakes in the western and south Delta, and the new City of Stockton water supply project that is currently under construction. The City of Antioch also has an important water supply intake at the western edge of the Delta, and purchases water from the Contra Costa Water District when

²⁷² Table 7-2a from DWR (2007) *Technical Memorandum: Delta Risk Management Strategy (DRMS) Phase 1 Topical Area: Impact to Infrastructure*, June 15, 2007.

the water quality at their intake deteriorates to poor levels.²⁷³ The Solano County Water Agency has a major water intake in the northwest Delta that serves significant areas in a Delta county and nearby Napa, but does not directly serve customers in the Legal Delta. The City of Tracy receives a portion of its supply from the federal Central Valley Project that serves areas to the south, but has added other supplemental supplies in recent years to reduce its dependence on this source.

Box 6 Salinity Impacts on Residential Users of Delta Water²⁷⁴

There are a range of factors, including rising sea level and conveyance options that may increase the salinity of Delta water. Whatever the cause, saltier source water requires more water and energy to produce quality drinking water and also generates greenhouse gas. Owing to their intakes' proximity to the San Francisco Bay, the western Delta communities typically bear the initial impacts of increased Delta salinity. The City of Antioch, for instance, has been diverting fresh water from its intake since the 1860s, but when salinity levels are too high to utilize this water, Antioch purchases water from CCWD for an additional \$750,000 per month or approximately \$3 million per season on average. Therefore, as rising salinity levels reduce the operating horizon for their intake, the cost of providing water to their customers rises. CCWD has estimated the impacts associated with a 20 percent increase in fall salinity at their Rock Slough intake to equate to an additional operating cost of \$94,000 per month due to increased releases from Vaqueros Reservoir and subsequent increased pumping to refill the reservoir. The additional energy requirements associated with increased use of Los Vaqueros Reservoir to dilute the saltier water would generate an additional estimated 190 metric tons of CO₂ emissions. Furthermore, CCWD is currently investigating a brackish water desalinization plant to be developed collaboratively with four other utilities. The estimated capital costs for this plant are between \$150 million and \$180 million, with annual operation and maintenance costs between \$10 million and \$13 million.

As for agriculture, water quality is a critical consideration for these users, although its impacts can be controlled to a greater extent than for agriculture by using modern water treatment procedures, which may be very expensive. Water quality impacts on agriculture are discussed in Chapter 7. There are numerous potential sources of significant changes to Delta water quality; several are discussed in the context of the scenarios below. However, the following two other factors may also significantly influence baseline Delta water quality.

1) It is the policy of the State to plan for 55 inches of sea-level rise by 2100, although there is a wide range of estimates available and little consensus among the scientific community. Regardless of the exact amount of sea level rise, rises in sea level approaching this number would have a significant effect on tidal action and salinity in the Delta. These effects could be partially mitigated by adaptive management and engineering, and by careful restoration of habitat designed to absorb tidal energy in the far western Delta and the Suisun Marsh. Maintenance and improvement of the levees on the eight western islands will become even more critical as sea level continues to rise.²⁷⁵

2) Changes in the water quality of the San Joaquin River are another significant factor affecting overall water quality of the Delta. Further degradation of the water quality in the San Joaquin

²⁷³ The City of Antioch is partially reimbursed for these purchases according to the terms of a 1968 settlement agreement between the City of Antioch and the DWR.

²⁷⁴ The impacts discussed in this box are derived from comments and consultations with both the City of Antioch and the Contra Costa Water District.

²⁷⁵ Figure D1 in Appendix D is a map which shows the western islands and tracts in the Delta that have been identified as being critical to buffer against saltwater intrusion.

River is a long-standing problem with no easy solution. Actions directed towards updating specified flow criteria to improve water quality through salinity objectives may be realized through changes to the Bay-Delta Plan by the State Water Resources Control Board (SWRCD).²⁷⁶

In addition to the intake facilities themselves there are several associated pipelines conveying water from and through the Delta. Utilizing the DWR DRMS Phase 1 study of infrastructure in the Delta, we identified approximately 50 miles of aqueduct in the Delta's current 100-year floodplain worth an estimated \$1.3 billion.²⁷⁷ It is important to recognize that municipal water users have exhibited significant gains in efficiency and the continuation of these trends will likely reduce the relative demands on in-Delta water supplies despite future growth in the megaregion.

5.2 Wastewater Management Systems for Delta Communities

Many Delta communities discharge treated wastewater into the rivers and sloughs of the Delta. Such discharges are regulated by the State and Regional Water Boards through National Pollutant Discharge Elimination System (NPDES) permits to provide protection of all designated beneficial uses in the Delta. In recent years, the Central Valley Regional Water Quality Board has ordered virtually all Delta wastewater dischargers to significantly upgrade their plants to advanced treatment. Some wastewater utilities are in the process of constructing new facilities, whereas others, including the Sacramento Regional County Sanitation District facility, the largest wastewater treatment facility discharging to the Delta, are in the planning stages after recent regulatory decisions by the Central Valley Regional Water Board. Although the costs vary between utilities, the costs for upgrades to advanced treatment are significant compared to secondary treatment.²⁷⁸ These treatment improvements may make some improvements to Delta water quality. This effort represents a significant investment from communities in and surrounding the Delta, and is an action item already in progress that supports the coequal goals.²⁷⁹

5.3 Impact of Policy Scenarios on Water Resources Infrastructure

• Isolated Conveyance Scenario:

The isolated conveyance scenario proposes construction of new intakes for exporting water from the Sacramento River to areas south of the Delta. Assuming that there is no separate action taken on San Joaquin River water quality, this would tend to reduce water quality in the entire Delta, which at present is sustained by the flow of relatively fresh Sacramento River water through the Delta. While it is reported that the current preferred conveyance alternative would include some through-Delta flow, the operating rules have not yet been fixed and there is no

²⁷⁶ Currently the SWRCB is targeting the summer of 2012 for adoption of these amendments to the flow and salinity objectives. For details see: http://www.waterboards.ca.gov/water_issues/programs/delta.shtml

²⁷⁷ These figures were derived from Table 7-2a in DWR (2007) *Technical Memorandum: DRMS Phase 1 Topical Area: Impact to Infrastructure*, June 15, 2007.

²⁷⁸ An example of the benefits derived from these investments in wastewater treatment facilities have been seen at the Port of Stockton where once the City of Stockton began operation of its nitrification facility a mile up river in 2006, aeration at the port was finally able to achieve their operating targets. (Source: DWR, *Final Report: Stockton Deep Water Ship Channel Demonstration Dissolved Oxygen Aeration Facility Project*, Department of Water Resources, 2010.)

²⁷⁹ Utilizing the DWR DRMS Phase 1 study, 15 wastewater treatment facilities were identified in the Delta's current 100-year floodplain worth an estimated \$2.2 billion. (Source: Table 7-2a in DWR, *Technical Memorandum: DRMS Phase 1 Topical Area: Impact to Infrastructure*, June 15, 2007. See Appendix J for further details.

consensus on the BDCP effects analyses. Therefore, it is likely that isolated conveyance will increase salinity in the Delta even though the extent of these impacts is uncertain. As discussed above, increased salinity will tend to raise industrial and residential water costs, particularly in the western Delta. This will be problematic for the communities dependent on Delta water, especially if these additional costs are not mitigated.

• **Habitat Conservation:** The proposed conversion to tidal wetlands of lands around the periphery of the Delta, principally in the Cache Slough area and in the South Delta, would be beneficial for a range of fish species because of the steady introduction of organic carbon into the rivers and sloughs of the Delta. However, this same increase in organic carbon can have a significant impact on municipal water supplies because it can only be treated with advanced water treatment technology. A general idea of the estimated costs associated with this advanced water treatment is presented in Table 54.²⁸⁰ While it is unlikely that all of the water providers in the Delta would need to implement advanced water treatment, it is illustrative of the potential impacts from the creation of environments for threatened and endangered species to thrive if they are located close to critical water supplies.

Table 54 Estimated advanced treatment costs

	MGD Capacity	Capital Costs (millions)	Annual O&M Costs (millions)
CCWD	125	\$94	\$7.2
NBA	121	\$40-\$90	\$9-\$29
Antioch*	38.0	\$12-\$28	\$2.2-9.1
Stockton	30.0	\$15	\$3.5
*Estimated from other utilities			

A strategy for creating additional tidal marshes that could have fewer impacts to Delta water quality would be to restore the sunken islands in the far western Delta (and also perhaps Frank's Tract) as tidal marshes and to convert what are presently managed wetlands in the Suisun Marsh to tidal wetlands. This could have less impact on the introduction of organic carbon into municipal water supplies and could help mitigate salinity intrusion into the Delta.

A second kind of conservation measure, restoration of historic floodplains to temporarily store floodwater, could also increase organic carbon loading. This generally requires the removal of levees or the construction of new set-back levees. Re-activation of historic floodplains contributes to flood control by reducing the peak water-surface elevation as a flood crests and stretching out the flood hydrograph. It also directly restores one important element of the natural ecosystem, the burst of organic carbon introduced to the aquatic environment during flood crest. However, because this is only a temporary burst, rather than a sustained introduction of organic carbon, and it only occurs during periods of high flows, the consequences for municipal water treatment are not as severe. An excellent example of this approach to floodplain restoration is provided by the proposed Lower San Joaquin Bypass project which would widen Paradise Cut and reduce peak-water surface elevations in the San Joaquin River as it passes Lathrop and Stockton.²⁸¹

²⁸⁰ Treatment costs in Table 54 are estimates provided in consultation with the Contra Costa Water District (CCWD), the City of Stockton, and the Solano County Water Agency (North Bay Aqueduct (NBA), The range of costs for Antioch are scaled estimates based on the range of capital and O&M costs provided by the other agencies. It is important to note that the actual cost will depend on the type of technology required.

²⁸¹ Lower San Joaquin River Flood Bypass Proposal, South Delta Levee Protection and Channel Maintenance Authority, submitted to California Department of Water Resources, March, 2011.

- **Open Water Scenario:** The open water scenario would entail the removal of the City of Stockton's Delta Water Supply intake on Empire Tract. This \$217 million project is currently under construction by the City of Stockton to replace surface water resources and protect groundwater supplies. Initially the intake will allow 30 million gallons per day (MGD) to be treated, with further expansion planned for capacity to treat up to 160 MGD.²⁸²

- **Higher-Standard Levees Scenario:** A failure of levees and the failure to restore flooded islands is yet another potential source of water quality degradation. As noted elsewhere, the ecological benefits of leaving islands flooded, or even deliberately breaching islands where the land surface is presently below sea level, are uncertain. What is clear, however, is that increasing open water in the Delta could have an adverse effect on adjacent islands as a result of increasing wave action and seepage forces, and could contribute to the conversion of the Delta from an estuarine ecosystem to that of a weedy lake. Water quality could be degraded as a result of increased salinity intrusion and as a result of more organic carbon and introduced organisms. These adverse effects would be mitigated by improving levees to a higher standard.

²⁸² Delta Water Supply Project website. Accessed at: <http://www.deltawatersupplyproject.com/>